Electrical Safety Presentation

Scottish House Builders Health & Safety Forum

4 November 2015

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Technical & Safety Adviser

SELECT

Presentation Content

- HSE concerns regarding electrical fatalities in Scotland 2000/2006 and resulting guidance
- Electrical safety management
- Temporary supplies to construction sites
- Inspection, testing and certification of electrical installations
- Recent changes to the IET Wiring Regulations relevant to domestic premises
- Examples of electrical incidents

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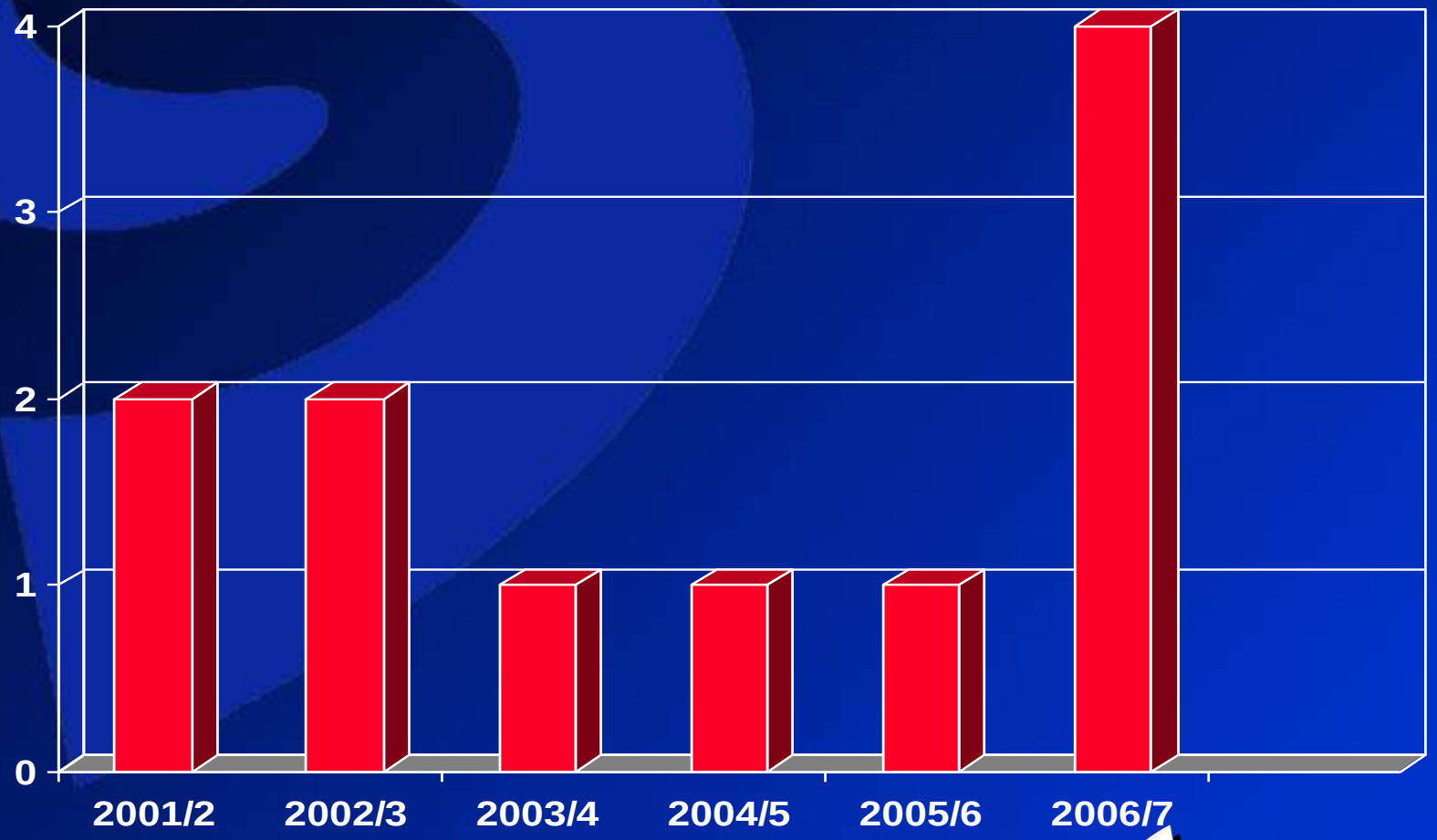
Matters of Concern to HSE in 2006

- A spate of fatal / major injury incidents
- Almost invariably such incidents were occurring on LV systems with few on HV networks, where systems of work tend to be more tightly controlled
- A number involved electricians working on new or existing installations, particularly on larger installations with more than one electrician on site
- Some incidents had involved other trades

Fatal Injuries to Construction Workers in Scotland due to Contact with Electricity or Electrical Discharge 2001-2007



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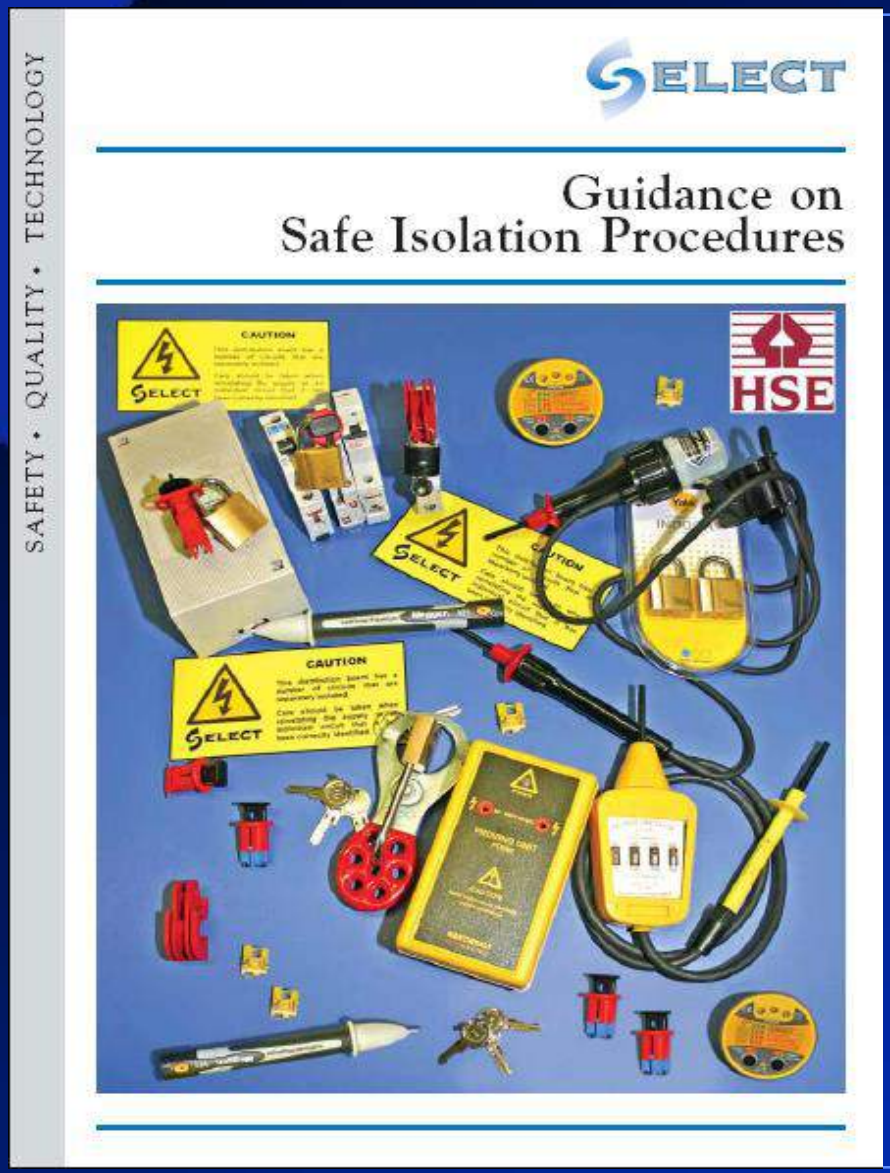
Matters of Concern to HSE (continued)

- Such incidents tended to fall into 2 categories:
  1. Failure to implement safe isolation procedures
  2. Working live instead of working dead
- Electrical contractors being persuaded to energise installations before they are complete
- The HSE asked SELECT, in conjunction with them, to provide practical guidance on LV safe isolation procedures



Published by SELECT September 2006

The guide explained what needed to be done to make sure workers on site are not exposed to danger when working on or near live electrical systems and equipment in buildings, particularly in the final stages of construction

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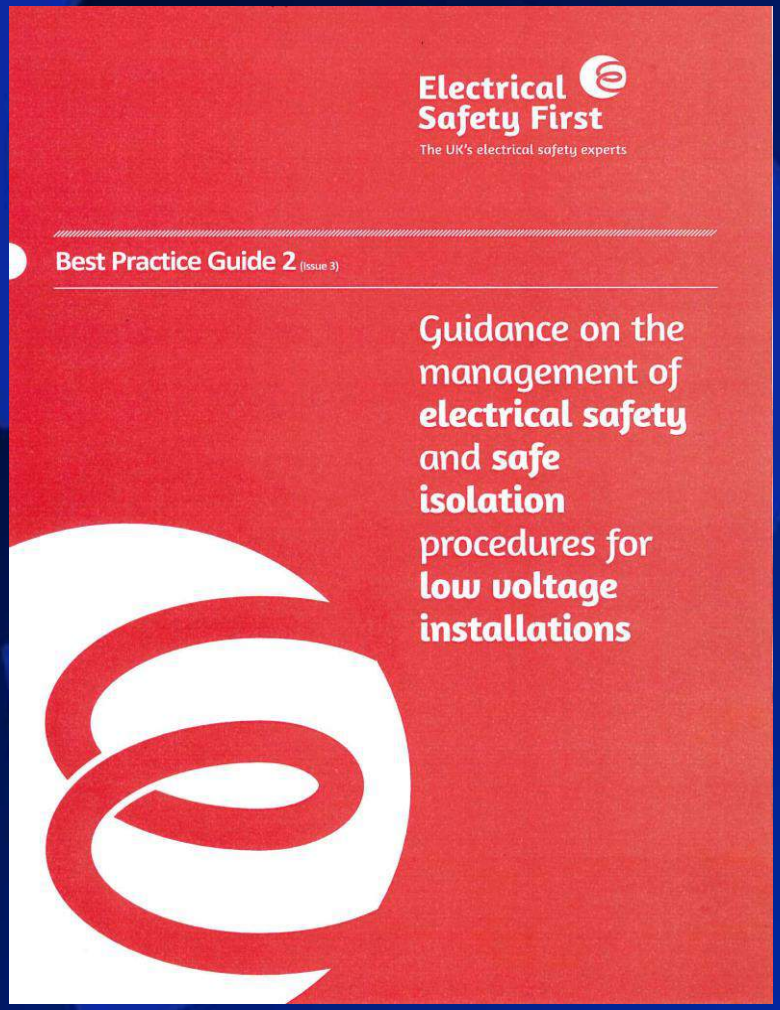

(Available for free download from SELECT and ESF websites)

Revised following a series of road shows by SELECT and HSE in 2009

Although the principles apply generally, the guidance is particularly relevant to circumstances where work is being carried out in the presence of other trades, and to sites where more than one electrician is employed

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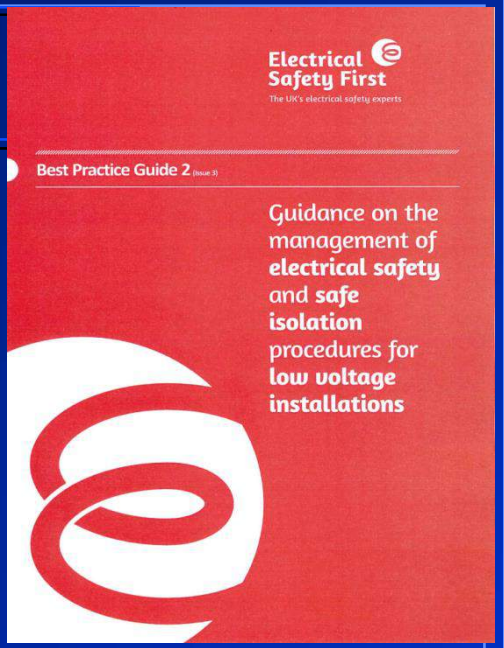
Electrical Safety Management



Safe working practices

- Guide applies not only to construction sites but also to refurbishment and maintenance
- Company-specific documents
- Operatives shown documents
- Site inductions and tool-box talks
- Operatives understanding of information
- Review of safety management documents

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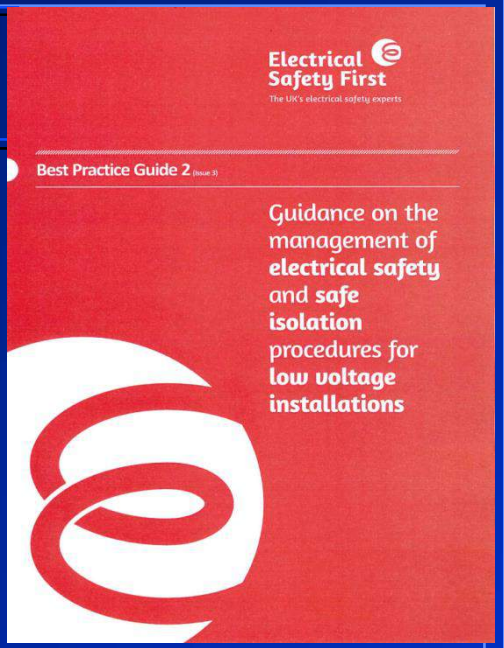
Electrical Safety Management



Overseeing the work – appoint a suitably experienced and competent person:

- Where work is carried out in presence of other trades or more than one electrical operative
- Appointed person's responsibilities include overseeing operatives and controlling work of sub-contractors
- May delegate control of specific tasks

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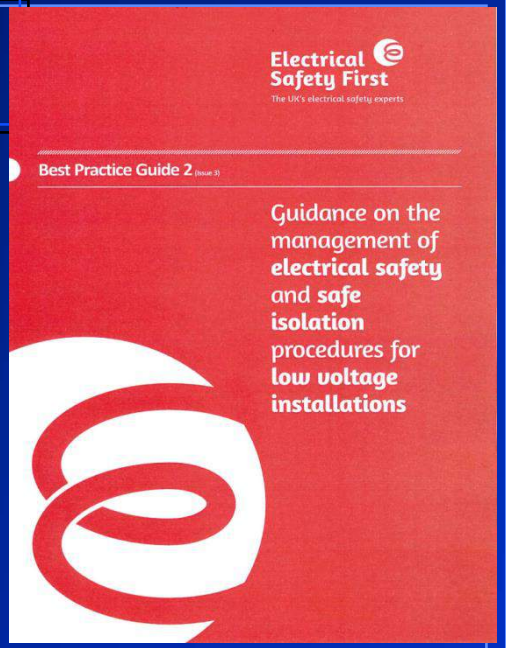
Electrical Safety Management

Energising incomplete installations



- Avoid energising until all circuits are complete and have been inspected and tested
- If live services are required before all circuits are completed the contractor should receive a written request from the principal contractor
- Prior to energising carry out safety procedures
- It is not reasonable to work on or near uninsulated live conductors on the grounds of convenience, or saving time or cost

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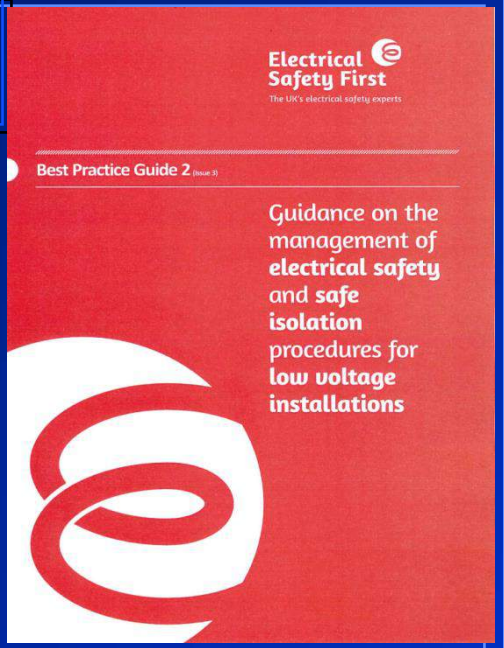
Electrical Safety Management

Energising prior to final Commissioning



- Make sure everyone on site is aware of any live circuits by displaying danger notices
- People entering completed and energised areas must be aware of their extent and assume all services are energised
- Electrical contractor must inform principal contractor when they intend to energise
- Contractors should advise employees at site inductions and toolbox talks

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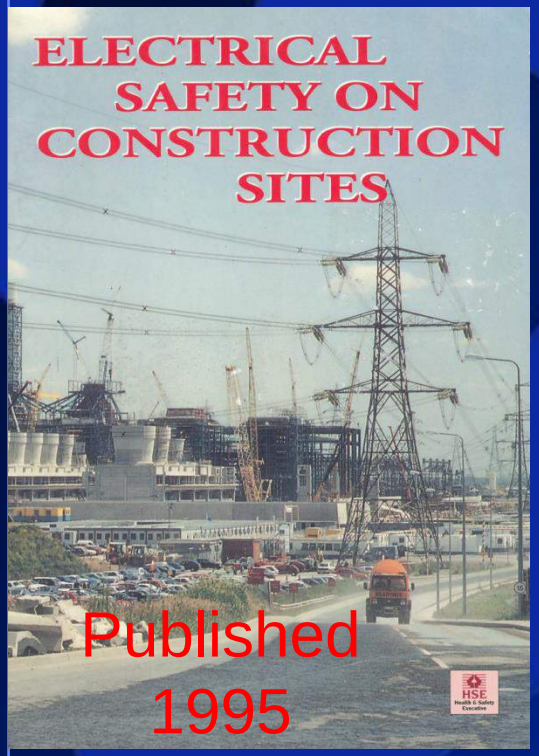
Temporary Supplies to Construction Sites



Published 1995

BS 7375:2010 Distribution of electricity on construction and demolition sites. Code of practice

Covers the use of distribution units

IET GN3 - recommended frequency of inspection of construction site installations is 3 months

HSG141(no longer available) Recommended annual inspection of site offices

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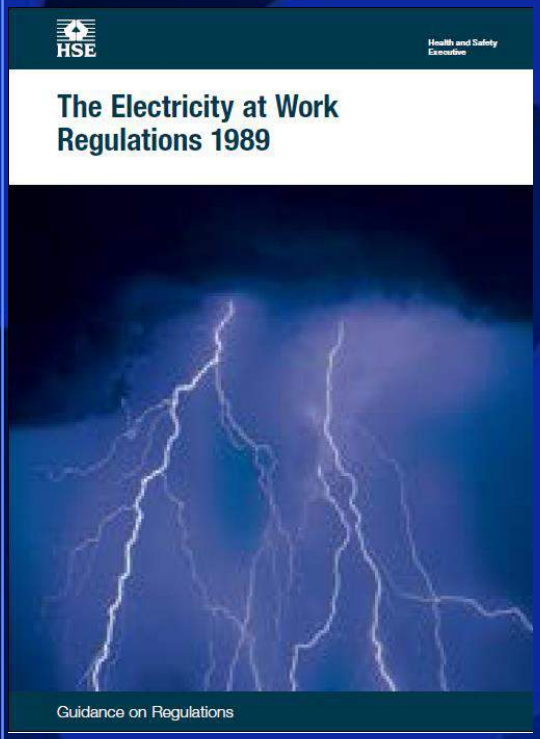
Legislation

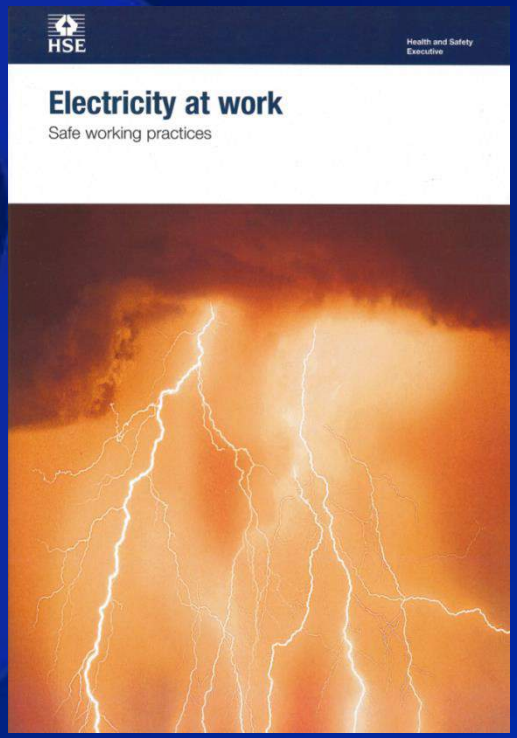
Electricity at Work Regulations 1989

- Require precautions to be taken against the risk of death or personal injury from electricity in work activities
- Employers should ensure that employees:
  - Implement safe systems of work; and
  - Have technical knowledge, training and experience; and
  - Have access to suitable tools, equipment and PPE and know how to use them

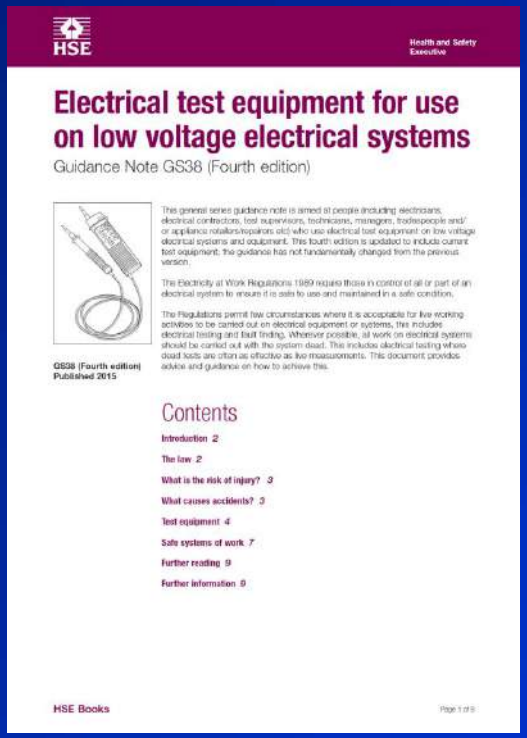
HSE Publications



HSR25 3rd Edition
October 2015



HSG85 3rd Edition
2013



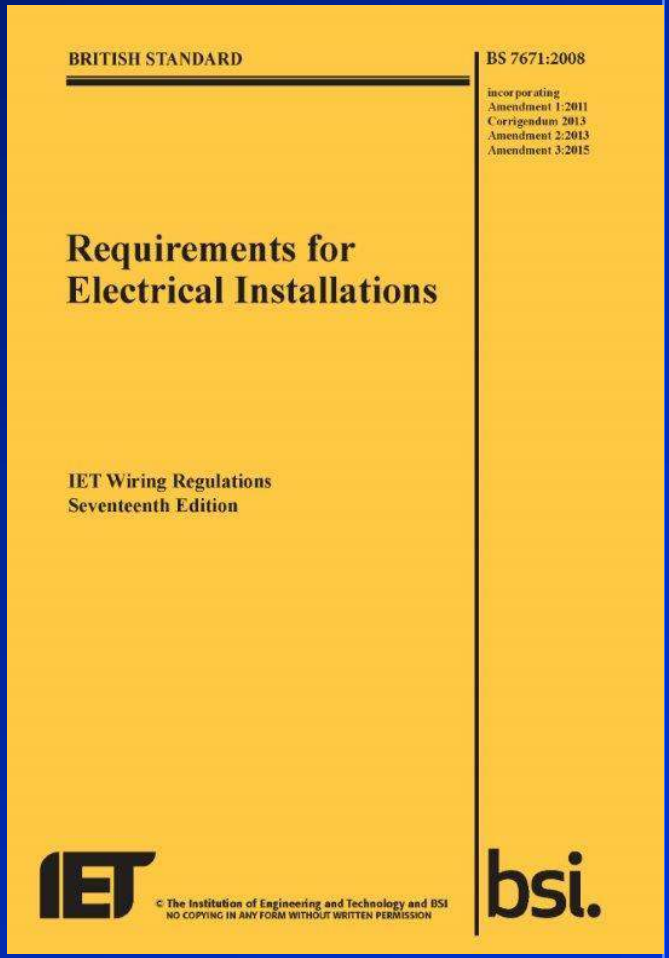
GS38 4th Edition
July 2015

All are available for free download from the HSE website

BS 7671: 2008 (2015)

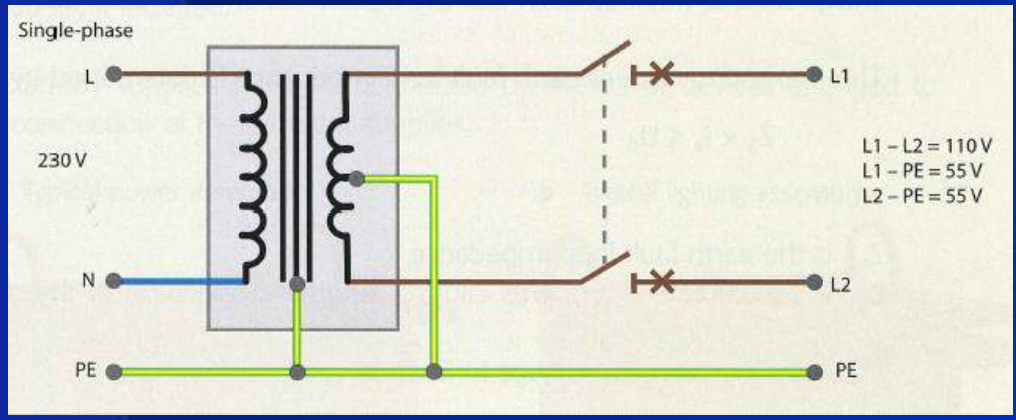
Came into effect 1 July 2015

Non-statutory, however electrical installations in the UK which comply with BS 7671 are likely to achieve conformity with Statutory Regulations such as the Electricity at Work Regulations 1989



BS 7671:2008(2015) Section 704 Construction and demolition site installations

Reduced Voltage Systems



For portable hand lamps for general use, portable hand tools and local lighting up to 2 kW

110 V centre point earthed is **strongly preferred**

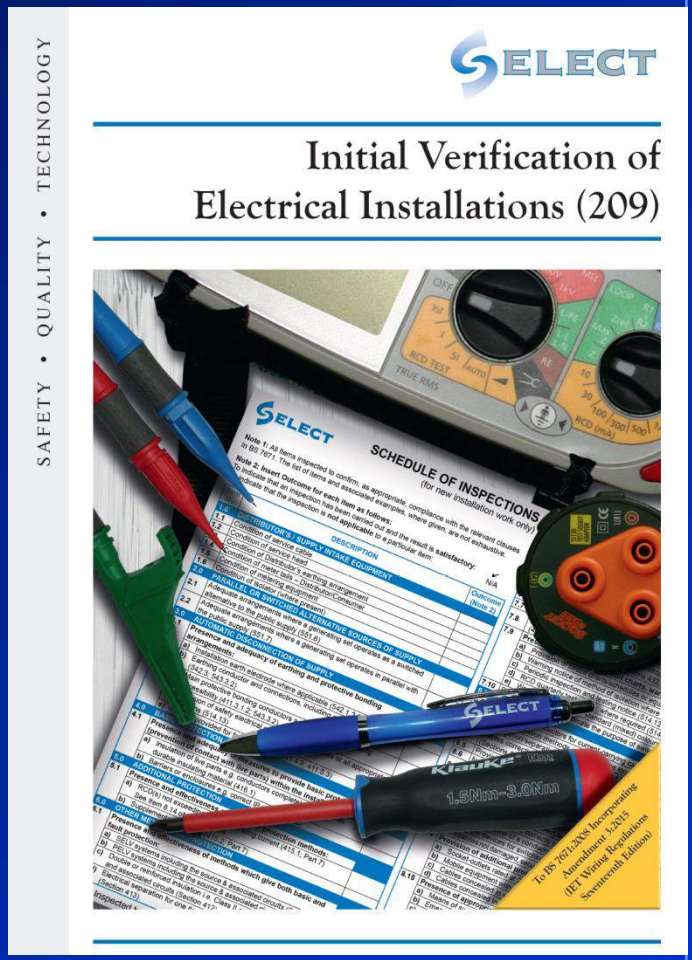
BS 7671: 2008 (2015)

Regulation 134.2.1

‘During erection and on completion of an installation or an addition or alteration to an installation, and before being put into service, appropriate inspection and testing shall be carried out by skilled persons competent to verify that the requirements of this standard have been met’

Skilled person (electrically)

Person who possesses, as appropriate to the nature of the electrical work to be undertaken, adequate education, training and practical skills, and who is able to perceive risks and avoid hazards which electricity can create



BS 7671: 2008 (2015)

Regulation 611.1

‘Inspection shall precede testing and shall normally be done with that part of the installation under inspection disconnected from the supply’

Regulation 612.1(part of)

‘The tests of Regulations 612.2 to 612.6, where relevant, shall be carried out in that order before the installation is energised’:

- Continuity of protective conductors
- Continuity of ring final circuit conductors
- Insulation resistance
- Polarity

Fatal consequences of inadequate or no testing

In March 2008 during the conversion of a building in Bristol into flats a 23 year old plumber was installing a washing machine next to the sink in one of the flats

He climbed into the sink cupboard head-first and reached around to adjust the legs of the machine

His head then came into contact with the water pipe and when he touched the casing of the machine (which was plugged in to a socket-outlet) with his hand he was electrocuted

Fatal consequences (continued)

The line and earth connections at the socket-outlet were subsequently found to be reversed, causing the machine casing to become live

The company's electrical division had signed the electrical work off as being satisfactory!

This fault would have been identified prior to energising the circuit had correct inspection and testing procedures been followed

A number of the Regulations in BS 7671:2008(2015) have been amended to take into account concerns regarding fires in and around the supply intake position and in escape routes in buildings

A NEW regulation 421.1.201 has been added

Regulation 421.1.201

Within domestic (household) premises, consumer units and similar switchgear assemblies shall have their enclosures constructed from a non-combustible material (e.g. steel), or alternatively be enclosed in a cabinet or enclosure constructed of non-combustible material

Regulation 421.1.201 (continued)

Such an enclosure will ensure that a fire will be contained

It will not, however, prevent a fault caused by a loose connection at the switch-disconnector, a circuit-breaker or the neutral bar from causing such a fire!

The implementation date for this Regulation is 1st January 2016

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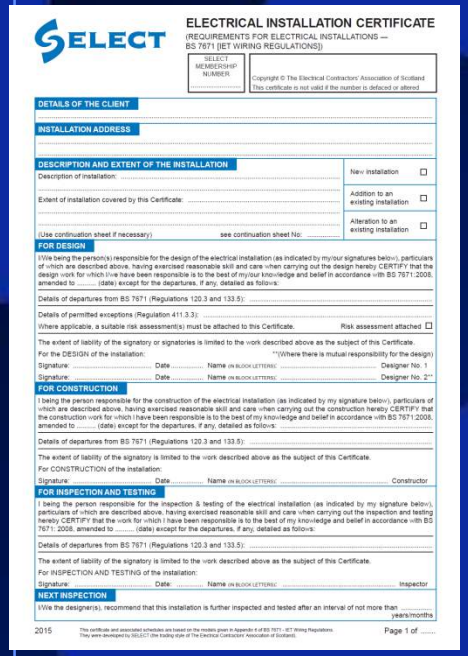
New Regulation 521.11.201

Wiring systems in escape routes shall be supported such that they will not be liable to premature collapse in the event of fire

Note: This precludes the use of non-metallic cable clips, cable ties or cable trunking as the sole means of support

Certification of New Installations



SELECT

ELECTRICAL INSTALLATION CERTIFICATE

(REQUIREMENTS FOR ELECTRICAL INSTALLATIONS — BS 7671 [IET WIRING REGULATIONS])

SELECT MEMBERSHIP NUMBER

Copyright © The Electrical Contractors' Association of Scotland
This certificate is not valid if the number is defaced or altered

DETAILS OF THE CLIENT

INSTALLATION ADDRESS

DESCRIPTION AND EXTENT OF THE INSTALLATION

Description of installation:

Extent of installation covered by this Certificate:

(Use continuation sheet if necessary) see continuation sheet No:

New installation ☐
Addition to an existing installation ☐
Alteration to an existing installation ☐

FOR DESIGN

I/We being the person(s) responsible for the design of the electrical installation (as indicated by my/our signatures below), particulars of which are described above, having exercised reasonable skill and care when carrying out the design hereby CERTIFY that the design work for which I/we have been responsible is to the best of my/our knowledge and belief in accordance with BS 7671:2008, amended to ..... (date) except for the departures, if any, detailed as follows:

Details of departures from BS 7671 (Regulations 120.3 and 133.5):

Details of permitted exceptions (Regulation 411.3.3):

Where applicable, a suitable risk assessment(s) must be attached to this Certificate. Risk assessment attached ☐

The extent of liability of the signatory or signatories is limited to the work described above as the subject of this Certificate.

For the DESIGN of the installation: **(Where there is mutual responsibility for the design)

Signature: ..... Date ..... Name (in BLOCK LETTERS): ..... Designer No. 1

Signature: ..... Date ..... Name (in BLOCK LETTERS): ..... Designer No. 2**

FOR CONSTRUCTION

I being the person responsible for the construction of the electrical installation (as indicated by my signature below), particulars of which are described above, having exercised reasonable skill and care when carrying out the construction hereby CERTIFY that the construction work for which I have been responsible is to the best of my knowledge and belief in accordance with BS 7671:2008, amended to ..... (date) except for the departures, if any, detailed as follows:

Details of departures from BS 7671 (Regulations 120.3 and 133.5):

The extent of liability of the signatory is limited to the work described above as the subject of this Certificate.

For CONSTRUCTION of the installation:

Signature: ..... Date ..... Name (in BLOCK LETTERS): ..... Constructor

FOR INSPECTION AND TESTING

I being the person responsible for the inspection & testing of the electrical installation (as indicated by my signature below), particulars of which are described above, having exercised reasonable skill and care when carrying out the inspection and testing hereby CERTIFY that the work for which I have been responsible is to the best of my knowledge and belief in accordance with BS 7671:2008, amended to ..... (date) except for the departures, if any, detailed as follows:

Details of departures from BS 7671 (Regulations 120.3 and 133.5):

The extent of liability of the signatory is limited to the work described above as the subject of this Certificate.

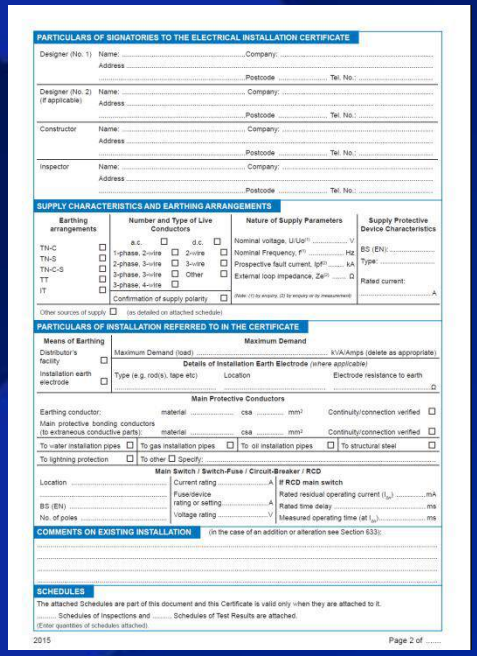
For INSPECTION AND TESTING of the installation:

Signature: ..... Date: ..... Name (in BLOCK LETTERS): ..... Inspector

NEXT INSPECTION

I/We the designer(s), recommend that this installation is further inspected and tested after an interval of not more than ..... years/months

2015 This certificate and associated schedules are based on the models given in Appendix 6 of BS 7671 - IET Wiring Regulations. They were developed by SELECT (the trading style of The Electrical Contractors' Association of Scotland). Page 1 of .....



PARTICULARS OF SIGNATORIES TO THE ELECTRICAL INSTALLATION CERTIFICATE

Designer (No. 1) Name: ..... Company: ..... Address: ..... Postcode ..... Tel. No.:

Designer (No. 2) (if applicable) Name: ..... Company: ..... Address: ..... Postcode ..... Tel. No.:

Constructor Name: ..... Company: ..... Address: ..... Postcode ..... Tel. No.:

Inspector Name: ..... Company: ..... Address: ..... Postcode ..... Tel. No.:

SUPPLY CHARACTERISTICS AND EARTHING ARRANGEMENTS

Earthing arrangements: TN-C ☐ TN-S ☐ TN-C-S ☐ TT ☐ IT ☐

Number and Type of Live Conductors: a.c. ☐ d.c. ☐ 1-phase, 2-wire ☐ 2-wire ☐ 2-phase, 3-wire ☐ 3-wire ☐ 3-phase, 4-wire ☐ Other ☐

Nature of Supply Parameters: Nominal voltage, U/Uo[1] ..... V; Nominal Frequency, f[1] ..... Hz; Prospective fault current, Ipf[2] ..... kA; External loop impedance, Ze[2] ..... Ω; Confirmation of supply polarity ☐ (Note: (1) by enquiry, (2) by enquiry or by measurement)

Supply Protective Device Characteristics: BS (EN): ..... Type: ..... Rated current: ..... A

Other sources of supply ☐ (as detailed on attached schedule)

PARTICULARS OF INSTALLATION REFERRED TO IN THE CERTIFICATE

Means of Earthing: Distributor's facility ☐; Installation earth electrode ☐

Maximum Demand: Maximum Demand (load) ..... kVA/Amps (delete as appropriate)

Details of Installation Earth Electrode (where applicable): Type (e.g. rod(s), tape etc) ..... Location ..... Electrode resistance to earth ..... Ω

Main Protective Conductors: Earthing conductor: material ..... csa ..... mm² Continuity/connection verified ☐; Main protective bonding conductors (to extraneous conductive parts): material ..... csa ..... mm² Continuity/connection verified ☐; To water installation pipes ☐ To gas installation pipes ☐ To oil installation pipes ☐ To structural steel ☐; To lightning protection ☐ To other ☐ Specify: .....

Main Switch / Switch-Fuse / Circuit-Breaker / RCD: Location ..... Current rating ..... A; Fuse/device rating or setting ..... A; Voltage rating ..... V; If RCD main switch: Rated residual operating current ($I_{\Delta n}$) ..... mA; Rated time delay ..... ms; Measured operating time (at $I_{\Delta n}$) ..... ms; BS (EN) ..... No. of poles .....

COMMENTS ON EXISTING INSTALLATION (in the case of an addition or alteration see Section 633):

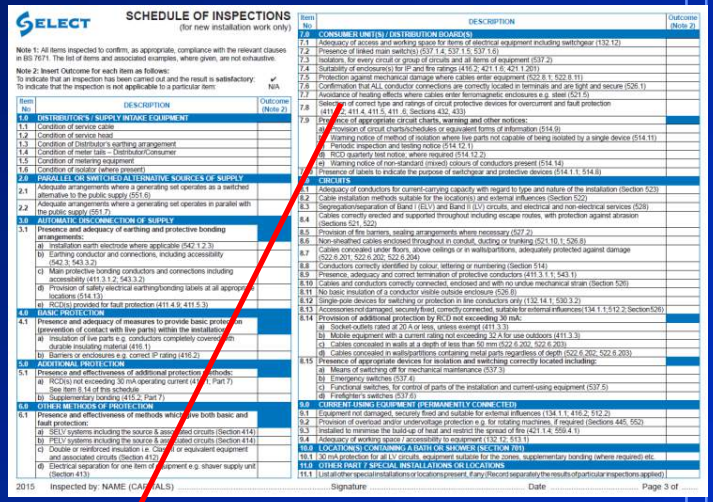
SCHEDULES

The attached Schedules are part of this document and this Certificate is valid only when they are attached to it.

..... Schedules of Inspections and ..... Schedules of Test Results are attached.

(Enter quantities of schedules attached)

2015 Page 2 of .....



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SCHEDULE OF INSPECTIONS

(for new installation work only)

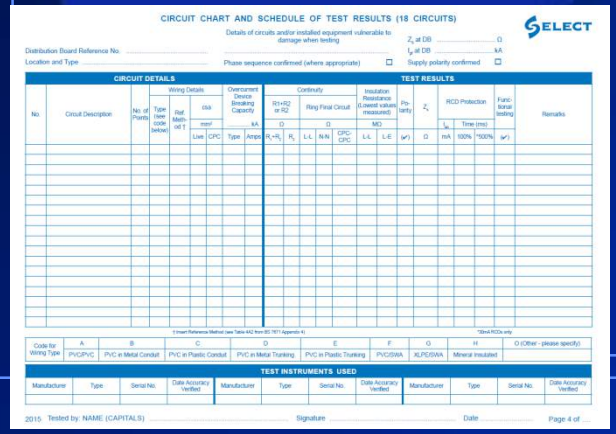
Note 1: All items inspected to confirm, as appropriate, compliance with the relevant clauses in BS 7671. The list of items and associated examples, where given, are not exhaustive.

Note 2: Insert Outcome for each item as follows:
To indicate that an inspection has been carried out and the result is satisfactory: ✔
To indicate that the inspection is not applicable to a particular item: N/A

Item No	DESCRIPTION	Outcome (Note 2)
1.0	DISTRIBUTOR'S / SUPPLY INTAKE EQUIPMENT	
1.1	Condition of service cable	
1.2	Condition of service head	
1.3	Condition of Distributor's earthing arrangement	
1.4	Condition of meter tails – Distributor/Consumer	
1.5	Condition of metering equipment	
1.6	Condition of isolator (where present)	
2.0	PARALLEL OR SWITCHED ALTERNATIVE SOURCES OF SUPPLY	
2.1	Adequate arrangements where a generating set operates as a switched alternative to the public supply (551.6)	
2.2	Adequate arrangements where a generating set operates in parallel with the public supply (551.7)	
3.0	AUTOMATIC DISCONNECTION OF SUPPLY	
3.1	Presence and adequacy of earthing and protective bonding arrangements: a) Installation earth electrode where applicable (542.1.2.3); b) Earthing conductor and connections, including accessibility (542.3; 543.3.2); c) Main protective bonding conductors and connections including accessibility (411.3.1.2; 543.3.2); d) Provision of safety electrical earthing/bonding labels at all appropriate locations (514.13); e) RCD(s) provided for fault protection (411.4.9; 411.5.3)	
4.0	BASIC PROTECTION	
4.1	Presence and adequacy of measures to provide basic protection (prevention of contact with live parts) within the installation: a) Insulation of live parts e.g. conductors completely covered with durable insulating material (416.1); b) Barriers or enclosures e.g. correct IP rating (416.2)	
5.0	ADDITIONAL PROTECTION	
5.1	Presence and effectiveness of additional protection by methods: a) RCD(s) not exceeding 30 mA operating current (411.3.3; Part 7) See Item 8.14 of this schedule; b) Supplementary bonding (415.2; Part 7)	
6.0	OTHER METHODS OF PROTECTION	
6.1	Presence and effectiveness of methods where/where both basic and fault protection: a) SELV systems including the source & associated circuits (Section 414); b) PELV systems including the source & associated circuits (Section 414); c) Double or reinforced insulation i.e. Class II or equivalent equipment and associated circuits (Section 412); d) Electrical separation for one item of equipment e.g. shaver supply unit (Section 413)	

Item No	DESCRIPTION	Outcome (Note 2)
7.0	CONSUMER UNIT(S) / DISTRIBUTION BOARD(S)	
7.1	Adequacy of access and working space for items of electrical equipment including switchgear (132.12)	
7.2	Presence of linked main switch(es) (537.1.4; 537.1.5; 537.1.6)	
7.3	Isolators, for every circuit or group of circuits and all items of equipment (537.2)	
7.4	Suitability of enclosure(s) for IP and fire ratings (416.2; 421.1.6; 421.1.201)	
7.5	Protection against mechanical damage where cables enter equipment (522.8.1; 522.8.11)	
7.6	Confirmation that ALL conductor connections are correctly located in terminals and are tight and secure (526.1)	
7.7	Avoidance of heating effects where cables enter ferromagnetic enclosures e.g. steel (521.5)	
7.8	Selection of correct type and ratings of circuit protective devices for overcurrent and fault protection (411.3.2; 411.4, 411.5, 411 .6; Sections 432, 433)	
7.9	Presence of appropriate circuit charts, warning and other notices:	
	a) Provision of circuit charts/schedules or equivalent forms of information (514.9)	
	b) Warning notice of method of isolation where live parts not capable of being isolated by a single device (514.11)	
	c) Periodic inspection and testing notice (514.12.1)	
	d) RCD quarterly test notice; where required (514.12.2)	
	e) Warning notice of non-standard (mixed) colours of conductors present (514.14)	
7.10	Presence of labels to indicate the purpose of switchgear and protective devices (514.1.1; 514.8)	

Inspector must check ALL connections in CU



CIRCUIT CHART AND SCHEDULE OF TEST RESULTS (18 CIRCUITS)

SELECT

Distribution Board Reference No. .....
Location and Type .....
Details of circuits and/or installed equipment vulnerable to damage when testing
Phase sequence confirmed (where appropriate) ☐
Z_s at DB ..... Ω
I_{pf} at DB ..... kA
Supply polarity confirmed ☐

CIRCUIT DETAILS / TEST RESULTS

No.	Circuit Description	No. of Points	Wiring Details: Type (see code below)	Ref. Meth. of Installation	Conductors: csa mm² Live	CPC	Overcurrent Device Breaking Capacity: Type	Amps	Continuity: R1+R2 or R2 Ω	Ring Final Circuit: R_1+R_2	R_1	L-L	N-N	Insulation Resistance (Lowest values measured): CPC-CPC MΩ	L-L	L-E	Polarity (✔)	Z_s Ω	RCD Protection: $I_{\Delta n}$ mA	Time (ms): 100%	*500%	Functional testing (✔)	Remarks

† Insert Reference Method (see Table 4A2 from BS 7671 Appendix 4) *30mA RCDs only

Code for Wiring Type	A	B	C	D	E	F	G	H	O (Other - please specify)
	PVC/PVC	PVC in Metal Conduit	PVC in Plastic Conduit	PVC in Metal Trunking	PVC in Plastic Trunking	PVC/SWA	XLPE/SWA	Mineral Insulated	

TEST INSTRUMENTS USED

Manufacturer	Type	Serial No.	Date Accuracy Verified	Manufacturer	Type	Serial No.	Date Accuracy Verified	Manufacturer	Type	Serial No.	Date Accuracy Verified

2015 Tested by: NAME (CAPITALS) ..... Signature ..... Date ..... Page 4 of .....

Electrical Burns Incident

In November 2008 a building Company were refurbishing flats in Aberdeen

A joiner attempted to move a redundant cut-out, thought to be dead, to fit plasterboard at the rear of it

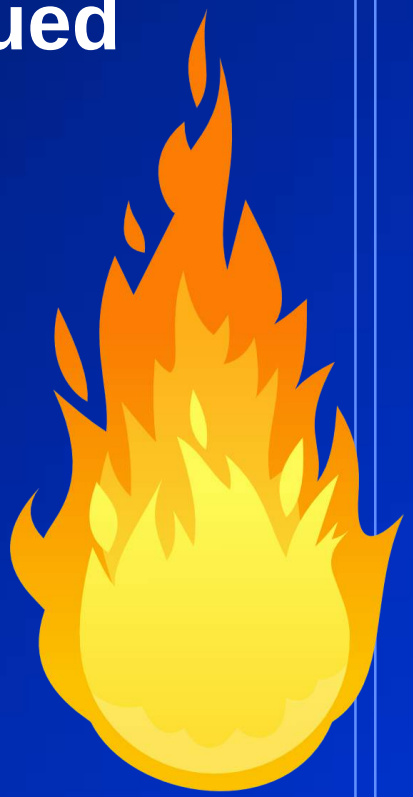
The cut-out was, in fact, still live and in moving it there was a short-circuit with sufficient energy to melt the cable and create a small explosion

Electrical Burns Incident - continued

The joiner's boilersuit was set on fire and he suffered burns to his face and hands

In September 2010 the firm was fined £9,000 and ordered to pay the joiner £4,000 in compensation

The HSE inspector stated that "It is extremely dangerous to make assumptions that electrical equipment is safe"



Incidents due to unsafe isolation

Electricians electrocuted due to failure to isolate and prove dead at point of work. Other major injury accidents with the same root cause.

The practice of placing PVC insulating tape over a circuit-breaker to prevent inadvertent switch-on is not a safe means of isolation.

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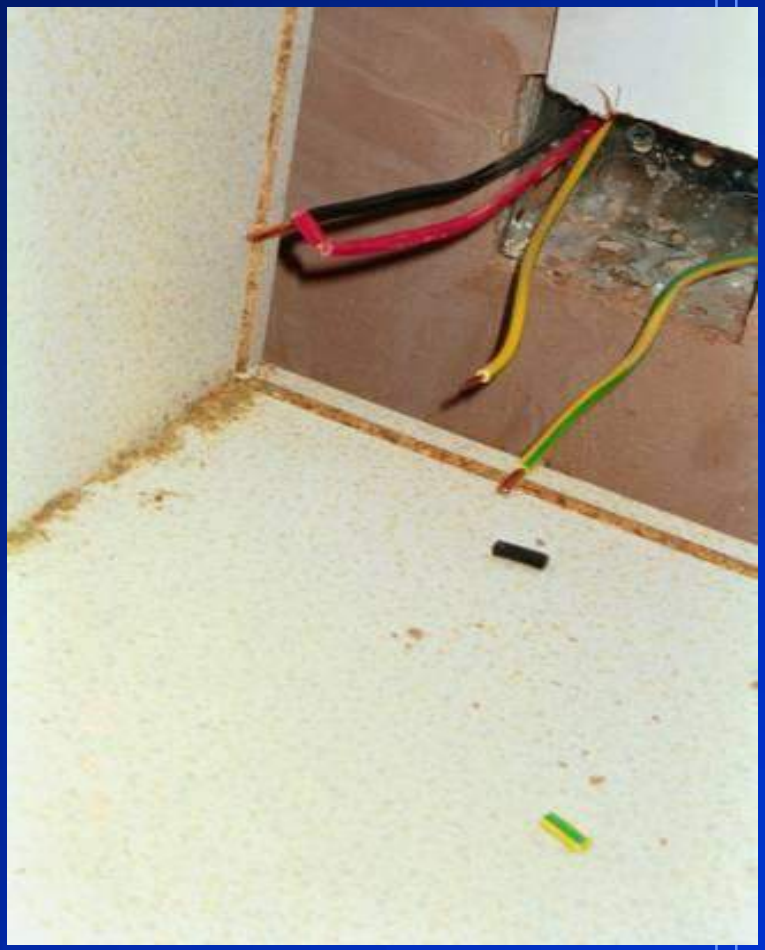
Another Fatal Incident

- An electrician was working underneath a sink
- The circuit-breaker for the circuit had been isolated using insulating tape
- His colleague switched it back on assuming the work had been completed
- The electrician stripped insulation of live conductor and was electrocuted



- The company was prosecuted (in England) and fined £100,000 in June 2007

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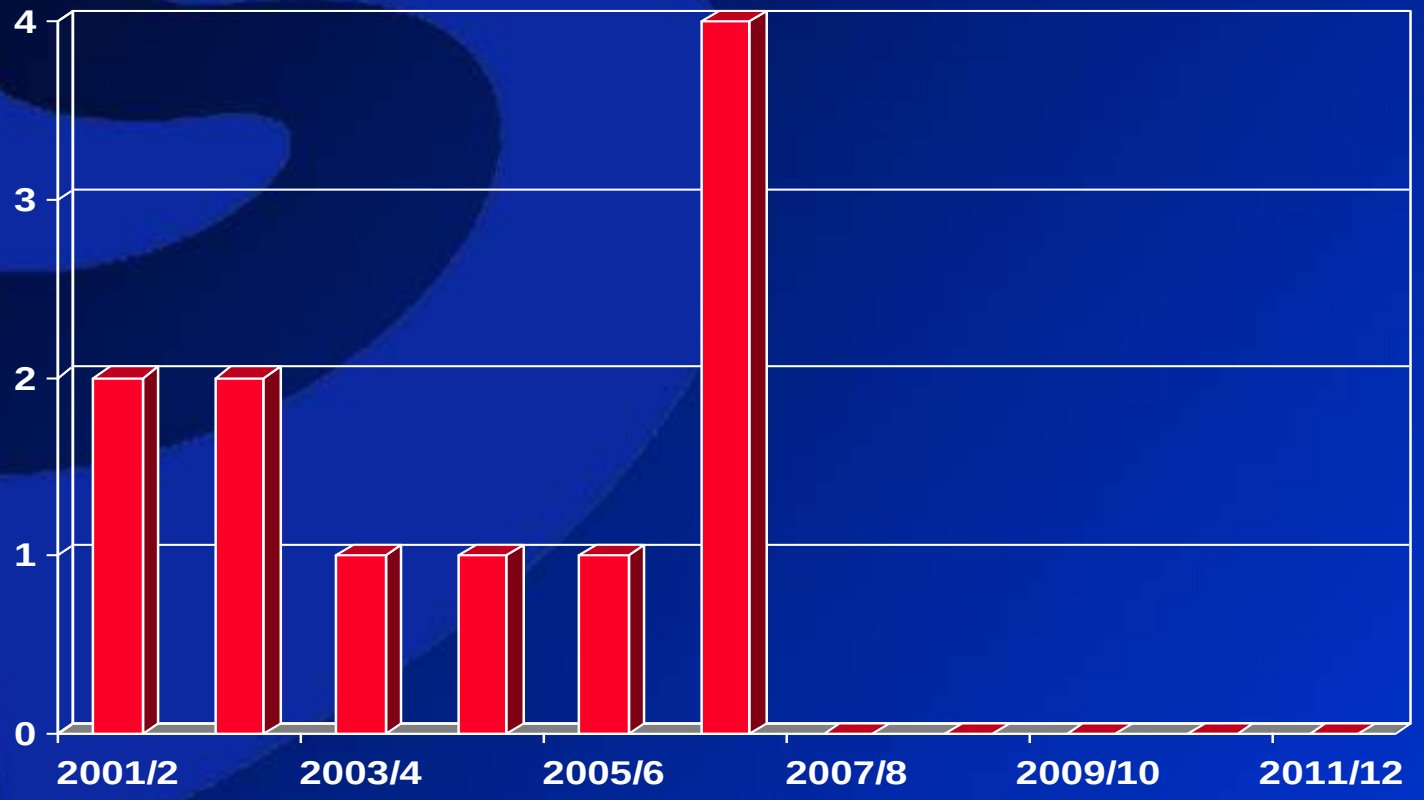
Example of use of circuit-breaker lockouts

Fatal Injuries to Construction Workers in Scotland due to Contact with Electricity or Electrical Discharge 2001-2012



Campaigns by HSE and SELECT appear to have paid off

Safe isolation procedures do work!

Any Questions?